Release 0.3

Rolling Thunder
Technical Reference Manual

INTRODUCTION

Introduction

Rolling Thunder™ consists of one transmitter in a Paragon 3 Rolling Thunder™ equipped locomotive and one Rolling Thunder™ receiver connected to a bass sub-woofer. The transmitted sounds range from 1hz to 1khz allowing great bass response never achievable in Ho model railroading.

DCC Characteristics

- 14 bit addressing
- 7 bit addressing (1-127)
- Operations mode support for all CV settings
- Configuration Variable Access Acknowledgement in Service mode
- Direct, Address Only, Physical Addressing and Paged CV Addressing Modes support in Service Mode including Write and Verify

DC characteristics

- DCMaster™ uses Direct Mode for CV Programming
- All CV's Programmable and Readable

General Characteristics

- Locomotive Mute Silences the Bass Sub-Woofer
- Locomotive Volume Controls the Bass Sub-Woofer Volume

ThunderTune™

- Tune you Thunder Sounds; Set the parameters best for your layout
- Full Graphical Display; Use Computer with Windows and USB Port
- Read Locomotive Track Voltage as the Locomotive Moves

Operation

Connect your Rolling Thunder™ receiver to your train track power using the supplied power cable. Connect your bass sub-woofer to the rca jack on the receiver and power on the sub-woofer. Once power is supplied to the receiver, the front led will blink rapidly about 5 seconds. ***During this time***, if service mode is detected, the receiver will accept any service mode commands. If service mode is not detected, the led lights solidly, indicating proper functioning. When a Rolling Thunder™ equipped locomotive reaches the vicinity of the receiver, the receiver starts to play the low frequency sounds received from the locomotive. As the locomotive moves away from the receiver, the sounds will diminish and go off until another Rolling Thunder™ equipped locomotive approaches the receiver. The distance of reception may be changed by varying the transmitter power CV213 in the locomotive.

Each Rolling Thunder™ locomotive should be set to a unique transmit frequency. CV212 and CV213 allows for 58 unique locomotive transmit frequencies.

Pressing the switch next to the led enters DCC programming in operations mode for the receiver. Pressing the switch causes the led to flash rapidly, indicating the receiver is ready to receive DCC commands. The bass sub-woofer is disabled during DCC programming. Several commands cause the receiver to reset (CV213, CV8=8) while all other CV writes will not cause a reset. Pressing the switch while the led is rapidly flashing in DCC programming mode exits DCC programming mode and the bass sub-woofer is enabled.

Operation

Factory Reset

Hold the switch for 3 seconds ***while*** apply power forces a receiver factory reset.

Operations Mode CV Programming

After the receiver is powered up ***using track power*** and stops flashing, press the button to enter DCC programming. The bass sub-woofer is disabled during DCC programming. Several commands cause the receiver to reset (CV213, CV8=8) while all other CV writes will not cause a reset. Pressing the switch while the led is rapidly flashing exits the programming mode.

Multiple Transmitters

Program the Rolling Thunder™ locomotive to a unique channel (CV212). The factory default is channel 1. Each transmitter must have a unique address. The receiver has a digital filter for the receive signal strength. As the locomotive gets closer and further away from the receiver, the signal strength increases or decreases. Once the receiver strength attains this level, the receiver locks to the locomotive. Once the signal strength reaches the signal level of CV135, the volume starts increasing at the rate specified by CV130, until the volume reaches maximum volume specified by CV131. The receiver scans the selected channels if insufficient signal strength is found. The signal strength necessary is set by CV141. The channels scanned are set by CV142 and CV143. For a single transmitter system, CV142 and CV143 are set to channel 1, the default transmitter channel.

Operation

The receiver only scans channels in the selected frequency sub-band, which is controlled by CV213. The transmitter and receiver must both be set to the same sub-band.

Default Receiver Mode: Single transmitter operating on channel one.

Please Note: The CV Defaults may vary from Locomotive to Locomotive.

SYSTEM CVs

CV	Description	Initial	Yours
1	Primary Address	1	
7	Manufacturer Version	?	
8	Manufacturer ID	38	
11	Packet Timeout	2	
17	Extended Address MSB	192	
18	Extended Address LSB	128	
29	Configuration Bits	0	
130	Volume Rate of Change	2	
131	Maximum Volume	128	
132	Minimum Volume	0	
133	RSS Digital Filter Coefficient	4	
135	Signal Strength Volume Increase	135	
136	Signal Strength Volume Decrease	111	
140	Signal Search Dwell Time	80	
141	Lock Signal Strength	100	
142	Start Scan Channel	1	
143	End Scan Channel	1	
213	Transmitter/Receiver Frequency/Power	192	

SYSTEM CVs

CV1
Receiver Primary Address

Description
The Receivers Primary Address is Stored Here
Values
Bits 0-6 contain an address with a value between 1 and 127
Initial Value
1
Related CVs
None

Bit 7							Bit 0
0	**A6**	**A5**	**A4**	**A3**	**A2**	**A1**	**A0**

The decoder responds to all valid commands if the address matches the value in CV1 and CV29 Bit 5 is set to 0.

Programming CV1 will program CV19 (Consists Address) to zero and programs CV29 Bit 5 to 0 (Extended Addressing Off).

SYSTEM CVs

CV7
Receiver Manufacturer Version Number

Description
The Decoders Read Only Type/Revision is Stored Here
Values

Initial Value

Related CVs
None

Bit 7							Bit 0
D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**

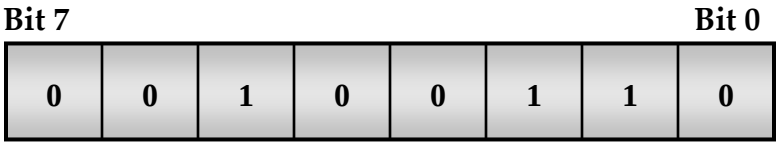
This value cannot be modified.

SYSTEM CVs

CV8
Receiver Manufacturer ID

Description
The Decoders NMRA Assigned Number is Stored Here. Broadway Limited is assigned ID 38.
Values

Initial Value
38
Related CVs



Setting CV8 to 8 resets all CVs back to their original manufactured values

Receiver Note: The receiver will automatically reset when this CV is changed.

SYSTEM CVs

CV11
Receiver Packet Time-Out Value

Description
Maximum Time in Seconds Between Valid DCC Packets.
Values
0-255
Initial Value
2
Related CVs

Bit 7							Bit 0
0	0	0	0	0	0	1	0

This value determines the maximum time elapsed in receiving a valid DCC packet.

SYSTEM CVs

CV17 and CV18
Receiver Extended Address

Description
This Value Contains the Decoders Extended Address and is Valid Only if CV29 Bit 5 is 1
Values
Values From 0 to 10239 are Valid
Initial Value
1100 0000 1000 0000 (Engine 128)
Related CVs
CV29 Bit 5

Bit 15							Bit 8
1	**1**	**A13**	**A12**	**A11**	**A10**	**A9**	**A8**

CV17 Extended Address MSB

Bit 7							Bit 0
A7	**A6**	**A5**	**A4**	**A3**	**A2**	**A1**	**A0**

CV18 Extended Address LSB

CV17 Valid Values are 1100 0000 thru 1110 0111
CV18 Valid Values are 0000 0000 thru 0000 0000

SYSTEM CVs

CV29
Receiver Configuration Bits

Description
Decoder Configuration Feature Bits
Values

Initial Value
0 (Primary Address)
Related CVs
CV1, CV17, CV18

Bit 7							Bit 0
0	**0**	**EA**	**0**	**0**	**0**	**0**	**0**

Bit 5: EA (Extended Address Mode Enable)
0 = Decoder Responds to Primary Address CV1
1 = Decoder Responds to Extended Address CV17, CV18
Bit 4: Not Used
Bit 2: Not Used
Bit 1: Not Used
Bit 0: Not Used

SYSTEM CVs

CV130
Receivers Volume Rate of Change

Description
Rate Volume Increases or Decreases with Signal Strength
Values

Initial Value
2
Related CVs
CV131, CV132, CV133

Bit 7							Bit 0
0	0	0	0	0	0	1	0

This value sets the rate of change of volume once the receiver detects the Rolling Thunder™ Equipped Locomotive. The volume is increased by this value. A larger number means the volume increases much quicker.

SYSTEM CVs

CV131
Receivers Maximum Volume

Description
Volume at Maximum Signal Strength
Values

Initial Value
128
Related CVs
CV130, CV132, CV133

Bit 7							Bit 0
1	0	0	0	0	0	0	0

Once sufficient signal is found, the volume increases to this maximum value.

SYSTEM CVs

CV132
Receivers Minimum Volume

Description
Volume at Minimum Signal Strength
Values

Initial Value
0
Related CVs
CV130, CV131, CV133

Bit 7							Bit 0
0	0	0	0	0	0	0	0

Once the signal falls to an insufficient value, the volume decreases by CV130 until this value (CV132) is reached.

SYSTEM CVs

CV133
RSS Digital Filter Coefficient

Description
Digital Filter Coefficient for the Receiver Signal Strength
Values
0-16
Initial Value
4
Related CVs
CV130, CV131,CV132

Bit 7							Bit 0
0	0	0	0	0	1	0	0

The receiver has a digital filter for the receive signal strength. As the locomotive gets closer and further away from the receiver, the signal strength increases or decreases. The signal level needs filtering. The filter coefficient determines the effect of change on the existing filtered level. As the value is increased, the filter changes slower. As this value is decreased, the filter changes faster.

SYSTEM CVs

CV135
Signal Strength Volume Increase

Description
Required Receiver Signal Strength to Increase Sub-Woofer Volume
Values
0-255
Initial Value
135
Related CVs
CV130, CV131,CV132, CV136

Bit 7							Bit 0
1	0	0	1	0	1	1	1

The receiver has a digital filter for the receive signal strength. As the locomotive gets closer and further away from the receiver, the signal strength increases or decreases. Once the receiver strength reaches this level, the volume starts increasing at the increment in CV130.

Note: This value must be greater than CV136.

SYSTEM CVs

CV136
Signal Strength Volume Decrease

Description
Required Receiver Signal Strength to Decrease Sub-Woofer Volume
Values
0-255
Initial Value
111
Related CVs
CV130, CV131,CV132, CV135

Bit 7							Bit 0
0	**1**	**1**	**0**	**1**	**1**	**1**	**1**

The receiver has a digital filter for the receive signal strength. As the locomotive gets closer and further away from the receiver, the signal strength increases or decreases. Once the receiver strength falls below this level, the volume starts decreasing at the increment in CV130.

Note: This value must be less than CV135.

SYSTEM CVs

CV140
Signal Search Dwell Time

Description
Channel Scan Signal Dwell Time
Values
0-255
Initial Value
80
Related CVs
CV141, CV142, CV143

Bit 7							Bit 0
0	1	0	1	0	0	0	0

The receiver has a digital filter for the receive signal strength. As the locomotive gets closer and further away from the receiver, the signal strength increases or decreases. A delay is necessary, allowing the signal strength to build so the strength can be read. Increasing this value allows more time, but will slow down the scan time, resulting in a delay to lock upon an approaching locomotive. Too small a value may not allow any signal lock.

SYSTEM CVs

CV141
Lock Signal Strength

Description
Required Receiver Signal Strength to Lock a Transmitter
Values
0-255
Initial Value
100
Related CVs
CV140, CV142, CV143

Bit 7							Bit 0
0	1	1	0	0	1	0	0

The receiver has a digital filter for the receive signal strength. As the locomotive gets closer and further away from the receiver, the signal strength increases or decreases. Once the receiver strength attains this level, the receiver locks to the locomotive. Once the signal strength reaches the signal level of CV135, the volume starts increasing at the rate specified by CV130, until the volume reaches maximum volume specified by CV131.

SYSTEM CVs

CV142
Start Scan Channel

Description
Channel Number the Receiver Starts Scanning
Values
1-29
Initial Value
1
Related CVs
CV143

Bit 7							Bit 0
0	0	0	0	0	0	0	1

The receiver is capable of scanning channels 1 through channel 29, searching for a Rolling Thunder™ locomotive that is withing range. This scan range can be limited from one locomotive to 29 locomotives. If this value is set to zero, the receiver is disabled. Any change from zero or to zero requires a reset before the receiver recognizes the change.

If CV142=CV143 no scanning is done. The receiver is fixed to one locomotive (**Default**).

Note: This value must be less than or equal to CV143.

SYSTEM CVs

CV143
End Scan Channel

Description
Channel Number the Receiver Starts Scanning
Values
1-29
Initial Value
1
Related CVs
CV142

Bit 7							Bit 0
0	0	0	0	0	0	0	1

The receiver is capable of scanning channels 1 through channel 29, searching for a Rolling Thunder™ locomotive that is within range. This scan range can be limited from one locomotive to 29 locomotives.

If CV142=CV143 no scanning is done. The receiver is fixed to one locomotive (**Default**).

Note: This value must be greater than or equal to CV142.

SYSTEM CVs

CV213
Transmit and Receive Frequency and Power

Description
This Value Sets the Receiver Frequency Band and Sensitivity
Values
0-255
Initial Value
128
Related CVs

Bit 7							Bit 0
f	**0**	**p**	**p**	**0**	**0**	**0**	**0**

This value sets the frequency sub-band and sets the receiver sensitivity. 0db is the maximum power. Value f is the frequency sub-band, pp is the receiver sensitivity.

fxppxxxx

f = 1 915 mhz
f = 0 868 mhz

pp = 11 -20db (248)
pp = 10 -14db (240)
pp = 01 -6db (232)
pp = 00 0db (224)